

Green Supply Chain Management – Motivation, Methods and Expectations – in Hungarian Automotive Oems

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SUMMARY

The aim of the paper is to analyse the green supply chain management (GSCM) practices of Hungarian automotive OEMs (original equipment manufacturers) – three car manufacturers and a truck manufacturer. For the analysis I performed a questionnaire survey that included the topics of motivation and barriers of GSCM, the methods applied, cooperation in the supply chain and green performance. The results show the importance of GSCM in Hungarian automotive OEM operation, the most improved fields and the most popular methods. We will see what the strongest motivation factors for green practices are, and what improvements the companies experience in their performance.

Keywords: supply chain management; green supply chain management; automotive industry; OEMs; Hungary

Journal of Economic Literature (JEL) codes: L24, L62

DOI: <http://dx.doi.org/10.18096/TMP.2016.01.05>

INTRODUCTION

Environmental issues are becoming increasingly important, especially in industries with great environmental impact. The automotive industry is one of these, and in addition, its customers are increasingly environment conscious. The automotive industry is also a good choice for researching supply chain management topics thanks to its outstanding level of supply chain management (SCM) practice. The aim of this paper is to analyse the green supply chain practice of Hungarian automotive original equipment manufacturers (OEMs). The article is focused around three main questions:

- What motivates OEMs to use green supply chain management (GSCM) techniques?
- What kind of methods and techniques are used by OEMs and how developed are the separate fields of GSCM?
- What type of outcomes do OEMs expect from GSCM, and what performance categories do companies monitor?

LITERATURE REVIEW – THE THEORETICAL BACKGROUND OF GREEN SUPPLY CHAIN MANAGEMENT

Green supply chain management fields and methods

One of the main directions of green supply chain management research is the clarification of its fields of application, and the investigation of the applied management methods and techniques. It is important to make a distinction between fields and principles, where **fields** are the green equivalents of supply chain activities within the company, with a defined set of methods and techniques (Gábel 2013). **Principles** are general management methods that do not belong to any field of SCM, such as: cooperation with the other members of the supply chain (Dakov & Novkov 2008; Hsu & Hu 2008; Zhu et al. 2008; Eltayeb et al. 2011; Chan et al. 2012; Lin 2013); recycling (Dakov & Novkov 2008; Hsu & Hu 2008; Lin 2013); life cycle management (Hsu & Hu 2008) organisational/management commitment (Hsu & Hu 2008; Zhu et al. 2008;) and investment recovery (sale

of excess inventories, materials, equipment, scrap materials with the aim of improving equipment usage) (Zhu et al. 2008; Chan et al. 2012)

The aim of **green design** (or eco-design) is the reduction of a product's environmental impact during its whole life cycle without compromising other essential product criteria, such as performance and cost (Eltayeb et al. 2011). In other words, green design means the design of products or services with certain environmental consciousness. This is also a key issue for the EU: a main objective is to develop a safe, diversified and environment-friendly energy structure in all member states, which is a complex goal for the future (Illés et al. 2013). Green design includes the design of products for reduced consumption of hazardous materials (Zhu et al. 2008; Eltayeb et al. 2011; Lin 2011); product design for reuse, recycling or remanufacturing (Zhu et al. 2008; Eltayeb et al. 2011) and product design for resource efficiency (Zhu et al. 2008; Eltayeb et al. 2011; Lin 2011).

The interpretation of **green purchasing** in the literature is quite uniform. Researchers have similar ideas about the aim and the methodology of green purchasing. The basic idea is decreasing the environmental impact caused by materials used in the products. This can be realised by the selection of appropriate materials and suppliers. Methods and techniques include demanding supplier certifications, environmental management systems (ISO14000, OHSAS18000, RoHS) (Zhu et al. 2008; Ninlawan et al. 2010; Eltayeb et al. 2011); supplier environmental auditing (Zhu et al. 2008; Hsu & Hu 2008; Ninlawan et al. 2010; Eltayeb et al. 2011); establishing environmental requirements for purchased items (Garcia Martinez et al. 2006; Chien & Shih 2007; Zhu et al. 2008; Hsu & Hu 2008; Ninlawan et al. 2010; Eltayeb et al. 2011; Chan et al. 2012; Chen et al. 2012); and professional and financial support to the supplier to reach environmental objectives (Zhu et al. 2008; Eltayeb et al. 2011).

A **green manufacturing** process should use inputs with low environmental impact, work with high efficiency and generate the minimal amount of waste and pollution. The methodology of green manufacturing includes decreasing resource utilisation (Srivastava 2008; Chen et al. 2012); hazardous substance control (Ninlawan et al. 2010; Chen et al. 2012); decreasing energy utilisation by energy-efficient technologies and increasing the ratio of green energy (Ninlawan et al. 2010; Chen et al. 2012); and integration of different forms of material reuse into the manufacturing process – disassembly, refurbishment, remanufacturing or recycling (Srivastava 2008; Ninlawan et al. 2010; Chen et al. 2012).

According to Ninlawan et al. (2010) and Chan et al. (2012) **green distribution** consists of green packaging and green logistics. Green packaging involves downsizing packages, using “green” packaging materials, cooperating with vendors to standardise packaging,

minimising material use and time to unpack, adopting returnable package methods, and promoting recycling and reuse programs. Green transportation or green logistics means delivering directly to the user's site, using alternative fuel vehicles, distributing in large batches and changing to more environment friendly modes of transport (modal shift).

Two interpretations of **reverse logistics** can be found in literature. One group of researchers (e.g. Srivastava 2008; Eltayeb et al. 2011) view certain types of reuse activities (such as disassembly, refurbishment, remanufacturing and recycling) as part of manufacturing or as a separate set of activities. The other group (e.g. Beamon 1999; Ninlawan et al. 2010; Lin 2013) view them as part of reverse logistics. Although both views have valid arguments, if we interpret conceptions correctly, only real logistics activities should be considered as part of reverse logistics; these are collecting, inspection and sorting, pre-processing and location decisions and network design (Srivastava 2008).

Motivation

According to Bala et al. (2008), environmental supply chains emerge where environmental and supply chain pressures are synthesised. These pressures may come from multiple directions. The two external driving factors that are recognised by most researchers are regulations and pressures from stakeholders (Kálmán 2002; Lin 2013). Srivastava (2008) defines three sources of pressure: economical, regulatory and consumer. Kumar et al. (2012) give a longer list of motivators by breaking down economic and consumer pressures into smaller elements. Testa & Iraldo (2010) pointed out that external factors alone cannot explain the different attitude to GSCM of companies operating in the same industry. Strategy, values and targeted competitive advantages are the internal factors that motivate companies differently in adopting GSCM. According to Stevels (2002), the members of the supply chain and other stakeholders can be positively affected by greening the supply chain. The advantages can be material, immaterial and emotional, and are motivators at the same time.

Managerial attitude as a barrier is mentioned by Beamon (2005) and Wooi & Zailani (2010). According to Côté et al. (2008) many small and some medium-sized companies had problems with environmentally conscious operation due to lack of time, financial resources and doubts about the benefits of green policies.

Several attempts were made to classify the motivating factors and barriers. The Green Business Network (2001) separated primary and secondary motivations, and distinguished between internal and external motivations in the primary group. Walker & Jones (2012) widened the scope to the barriers of GSCM. They divided both motivations and barriers into internal and external categories. My two-layered model of motivations and barriers expresses the difference between

coercive and soft factors (first layer), while the second layer is about the internal/external and enabler/barrier type of factors. Coercive factors mean explicit pressure on organisations, while soft factors are rather enablers than motivators: they help the successful adoption of GSCM but they cannot force its adoption (Gábel 2014).

Possible outcomes of applying GSCM

Environmental performance is considered the most important result of GSCM, since this is the primary motivation for applying its techniques. Environmental performance is interpreted as the reduction of several negative environmental effects. The most often mentioned elements in the literature are: reduction of waste output and emission, a smaller carbon footprint (Beamon 1999; Eltayeb et al. 2011; Dey & Cheffi 2012; , Kumar et al. 2012; Zhu et al. 2012; Dos Santos et al. 2013); reduction of material usage (Beamon 1999; Kumar et al. 2012); reduction of usage of harmful materials (Beamon 1999; Eltayeb et al. 2011; Dey & Cheffi 2012; Zhu et al. 2012); reduction of energy and water consumption (Kumar et al. 2012; Dos Santos et al. 2013); reduction of packaging material usage (Kumar et al. 2012; Dos Santos et al. 2013); and reduction of accidents and safety issues (Eltayeb et al. 2011; Dey & Cheffi 2012, Zhu et al. 2012.).

The second most often mentioned effects are the ones on **economic performance**. Economic effects on company performance can be measured primarily in the form of financial and market advantages or disadvantages. Authors define several positive effects, most of which are deductible from environmental effects: reduction of energy consumption cost (Dey & Cheffi 2012; Zhu et al. 2012; Lin 2013); reduction of direct materials cost (due to less material used) (Dey & Cheffi 2012; Zhu et al. 2012; Lin 2013); reuse of materials (Al-zaidi & Dunay, 2016), reduction of waste disposal cost (Dey & Cheffi 2012, Zhu et al. 2012; Lin 2013); reduction of fees and penalties (Illés & Kohlhéb, 1999; Dey & Cheffi 2012; Zhu et al. 2012; Lin 2013); and increase of revenues and market share (Eltayeb et al. 2011; Dos Santos et al. 2013).

The strongest negative effects appear in this category. These are caused by the large investment requirements of GSCM. The most important effects are the increased investments and the increased material costs (due to more expensive materials) (Lin 2013).

According to the most widely accepted interpretation of **operative performance**, the effects are basically economical ones, but their effect on the performance of the whole company is indirect (Eltayeb et al. 2011; Dey & Cheffi 2012; Zhu et al. 2012). Operational performance elements mentioned most often

in literature are: improved product and service quality (Eltayeb et al. 2011; Dey & Cheffi 2012; Zhu et al. 2012); improved flexibility (Eltayeb et al. 2011); reduced inventory (Dey & Cheffi 2012; Zhu et al. 2012) and high capacity utilisation (Dey & Cheffi 2012; Zhu et al. 2012).

Besides environmental, economic and operational performance, Eltayeb et al. (2011) define a fourth category, called **intangible outcomes**, which include growing customer satisfaction and loyalty, employee satisfaction, growing brand value, enhanced publicity and marketing opportunities, and better acceptance by local communities.

MATERIALS AND METHODS

The empirical data used in this study consist of questionnaire responses from managers of Hungarian automotive OEMs. Three car manufacturers and one truck manufacturer, all operating in Hungary, were involved. This is 100% of the OEMs in the Hungarian car and truck manufacturing industry. The three car manufacturers are affiliates of global companies, while the truck manufacturer is owned by the Hungarian state and other shareholders.

The questionnaire involved four sections about different aspects of GSCM. The questions were prepared based on the literature. The aim of the **Motivation section** was to find and rank the factors that influence companies in applying GSCM. I have used the categories defined in Gábel (2014). In the **Green supply chain management section** I collected 27 GSCM methods mentioned in the literature, grouped by type (principle or SCM field of activity). The **Cooperation in supply chain section** inquires about the form and intensity of cooperation with buyer and supplier partners. The **Green supply chain performance section** explores the performance categories and indices measured by companies, as well as the expected and observed changes in performance. The language of the questionnaire was Hungarian.

RESULTS

Motivation

Figure 1 shows the explicit pressure experienced by the companies from different external sources. The strongest pressure comes from consumers, parent companies (in the case of affiliates) and national or EU regulations. Local regulations have lower relevance. Pressure from different NGOs has virtually no significance.

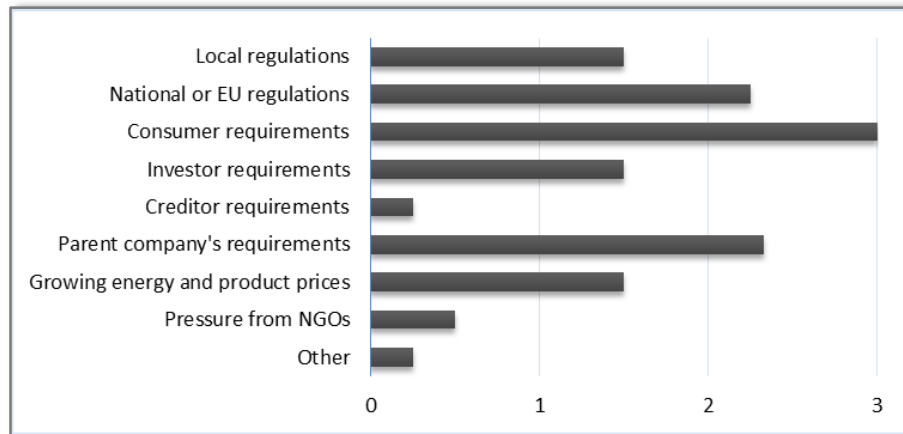


Figure 1 Strength of coercive motivation factors (0 no pressure, 1 slight pressure, 2 moderate pressure, 3 strong pressure)
Source: own research

Soft motivation factors were grouped as internal and external enablers and internal and external barriers, as is shown in Figure 2. The factors that were rated with

at least moderate significance by the OEMs are given in bold.

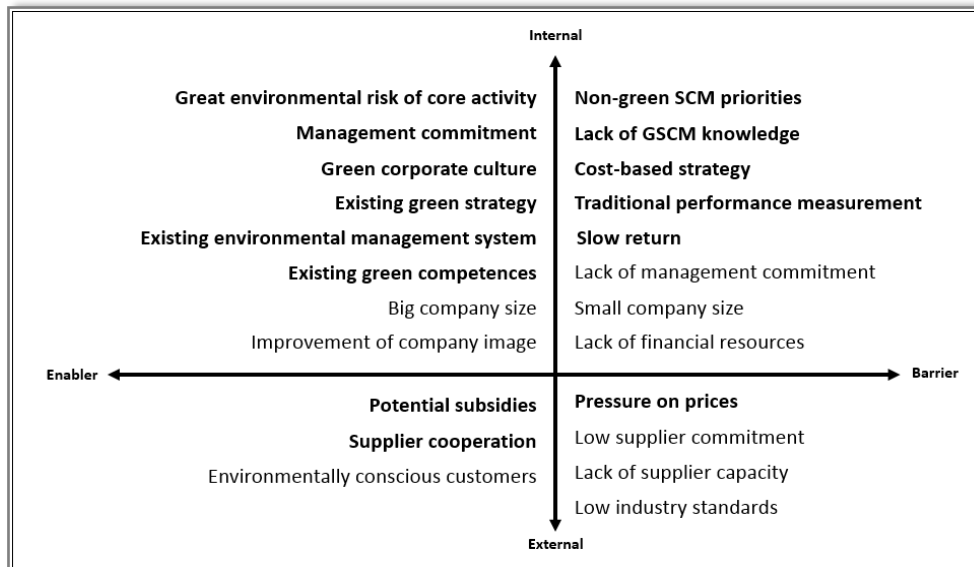


Figure 2 Soft motivation factors and their relevance for Hungarian OEMs
Source: own research based on Gábríel (2014)

The strongest group of factors for OEMs was the internal enablers, where 6 out of 8 factors were rated as being of at least moderate significance. The strongest motivators were the great environmental risk of core activity and management commitment. Most of the strong factors in this group (commitment, strategy, competences and culture) are due to the global parent company. These factors are only slightly significant for the Hungarian state-owned company. External enablers have weaker effects; the most important factor was potential subsidies for environmental development. Less than the half of the internal barriers mentioned in the literature turned out to be relevant for the sample companies. The strongest factors were other (non-green) SCM priorities and cost-

based strategy. Only 1 of 4 external barriers – pressure on prices – was rated as being more than moderately significant.

GSCM activities

Green design activities (design for reduced consumption of hazardous materials, for reuse and for resource efficiency) have great importance for OEMs, since they are responsible for the design of the end product of the supply chain. Green design methods are applied or being implemented by 75% of sample companies, as is shown in Figure 3.

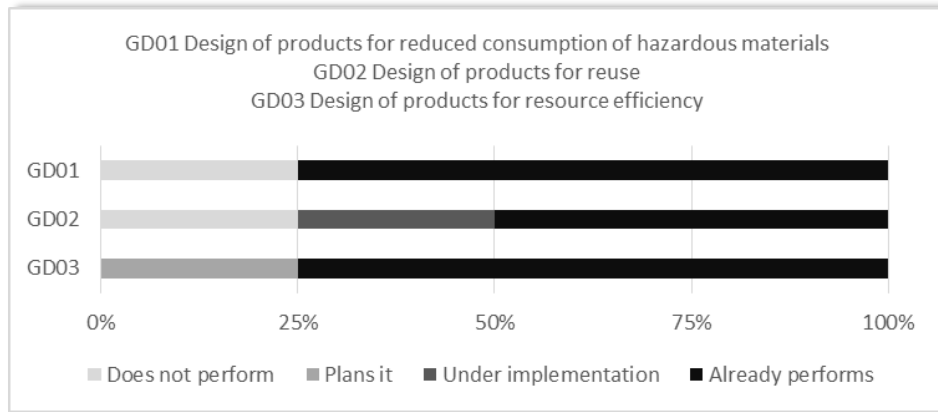


Figure 3 Green design methods applied by Hungarian OEMs

Source: own research

Green purchasing is the most important element of green SCM in the literature, regarding both the number of articles dealing with the topic and the number of techniques mentioned. Hungarian OEMs use a rich toolkit of green purchasing; all techniques mentioned in the literature are used by at least one company of the sample (see Figure 4).

The most popular group of techniques is setting different requirements for the supplier, with the aim of providing environmentally appropriate products and operation. All companies demand product testing reports and bills of materials from suppliers and provide them with design specifications. Demanding supplier

certifications or environmental management system, replacing materials with environmentally less harmful ones, setting environmental requirements for purchasing items and demanding product content labelling from suppliers are also popular techniques (3 out of 4 companies apply them).

The different methods of supplier development, such as supplier education in environmental topics, professional and financial support to the supplier and second tier supplier environmental evaluation are less frequently used methods (1 or 2 OEMs perform them), but most companies plan or are starting to implement them.

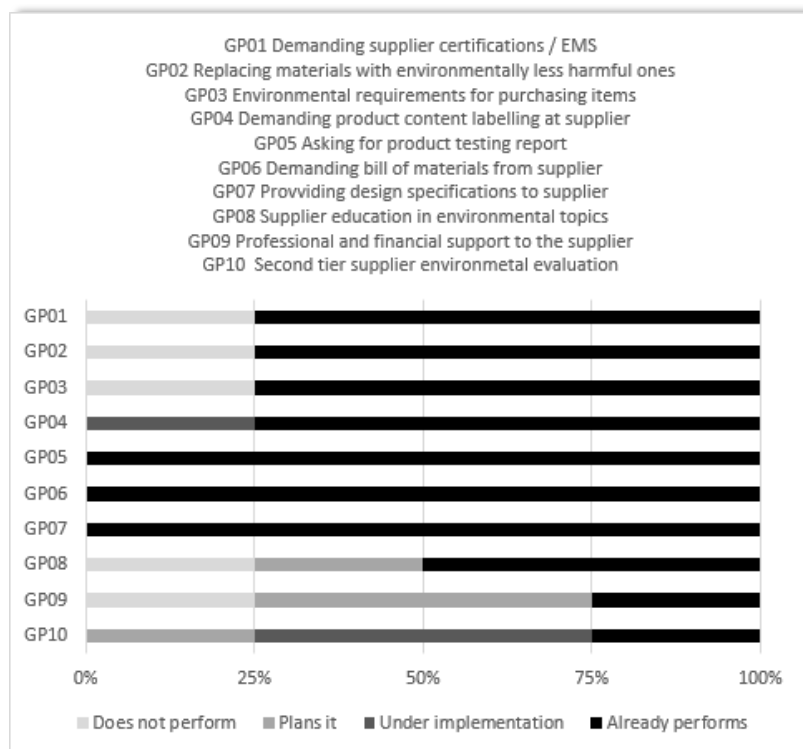


Figure 4 Green purchasing methods applied by Hungarian OEMs

Source: own research

Three methods of **green manufacturing** (decreasing resource utilisation, decreasing energy utilisation by energy-efficient technologies and hazardous substance control) are already implemented in 75% of the sample companies, all of which are affiliates of global

companies. The fourth method, integration of different forms of reuse into the manufacturing process is not yet applied but is planned by all four OEMs. The results are shown in Figure 5.

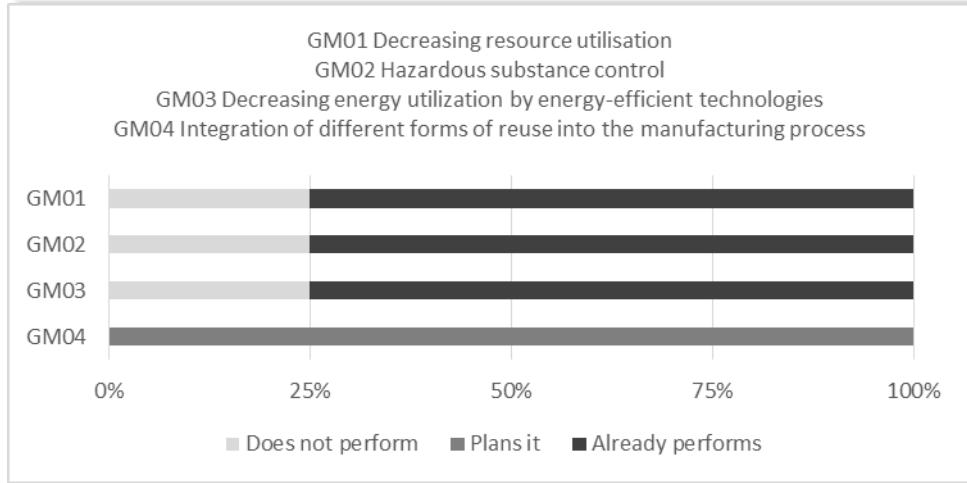


Figure 5 Green manufacturing methods applied by Hungarian OEMs
Source: own research

The implementation of **green distribution** methods shows a heterogenous picture (see Figure 6). Green logistics, including distribution in large batches and modal shift, is performed on a high level (applied or at

least planned by all companies), while green packaging is applied only by half of the companies. None of them performs or plans reverse logistics activities.

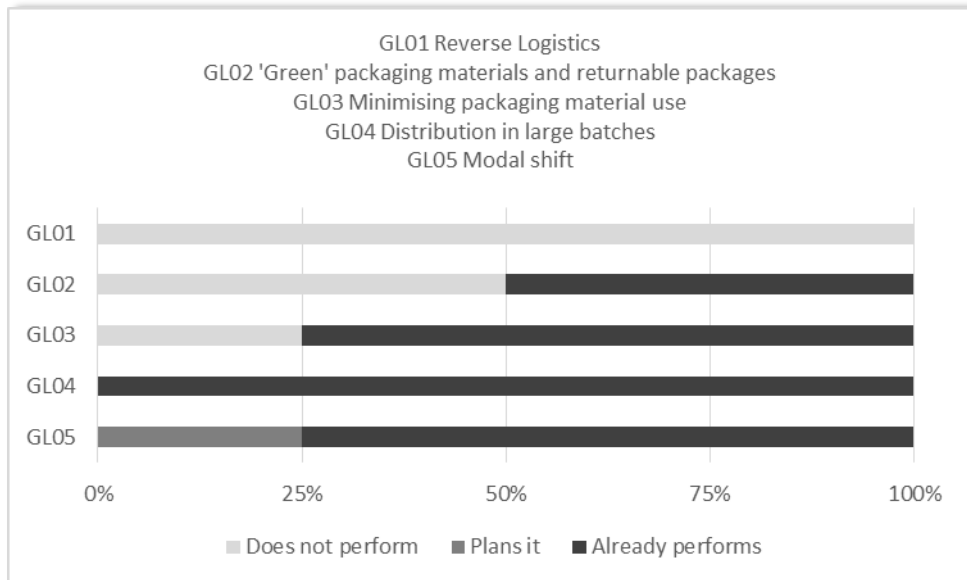


Figure 6 Green distribution methods applied by Hungarian OEMs
Source: own research

GSCM performance

Companies had to give weights to each performance category mentioned in the literature, where

the sum of weights had to be 100%. The results show that environmental performance is slightly less important for OEMs than economic and operative performance, while intangible outcomes are the lowest rated (see Figure 7).

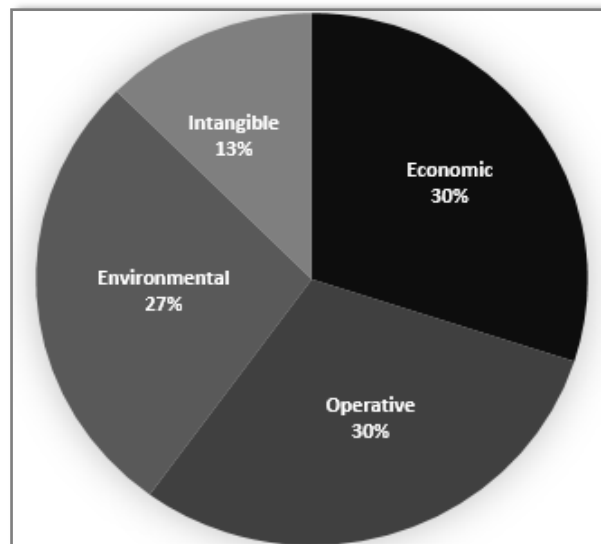


Figure 7 Relative importance of GSCM performance categories

Source: own research

Companies were asked to choose the three most important performance indicators in each performance category. Figure 8 shows the indicators that turned out to be the most emphasised and most intensively monitored ones. Out of **economic performance** indicators, reduction of direct materials cost and reduction of energy consumption cost are the most often mentioned ones. In **operative performance** the reduction of operational costs, reduced inventory and high capacity utilisation

were in the top three. The answers for **environmental performance** indicators were more heterogeneous: reduction of waste output and emission, reduction of material usage, reduction of energy consumption, reduction of usage of harmful materials and reduction of accidents and safety issues were mentioned by at least half of the companies. Growing customer satisfaction and loyalty, and growing brand value were considered the most important **intangible outcomes** by all companies.

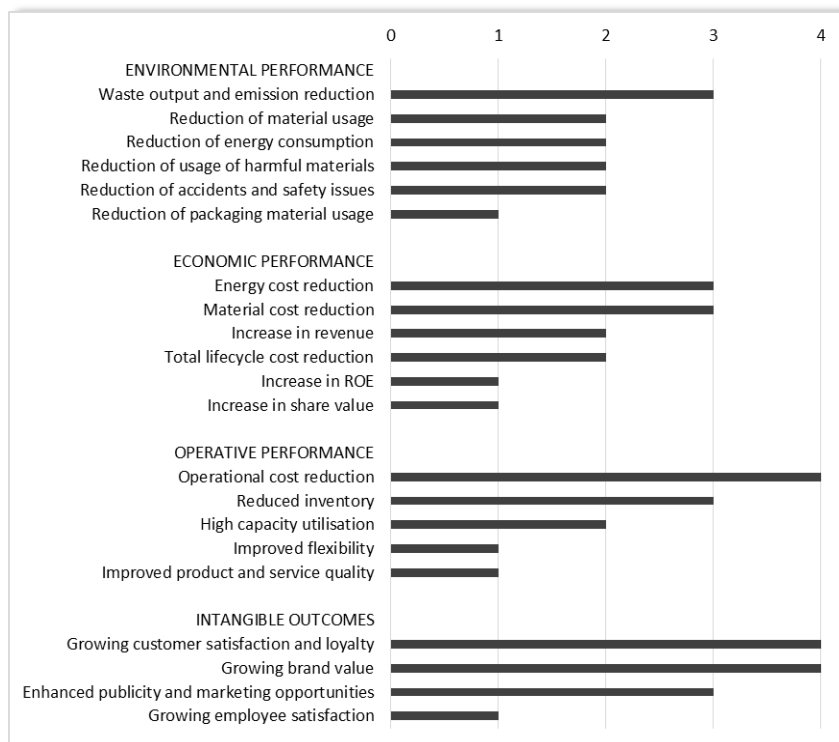


Figure 8 Performance indicators highlighted by OEMs (number of mentions as most important)

Source: own research

CONCLUSIONS

Automotive OEMs in Hungary face both regulatory and market pressures that motivate them to apply green methods in their supply chain processes. The fact that all Hungarian car manufacturers are affiliates of global automotive companies explains the strength of internal enablers, which are closely related to corporate strategy and corporate culture. The main barriers have economic reasons: high investment needs and cost pressure from consumers.

Since OEMs are responsible for product design, green design has the largest importance in this echelon of the supply chain. The results correspond with this assumption, as OEMs apply all green design methods. In the automotive industry OEMs control the supply chain. This explains the large number and great intensity of green procurement activities. Setting up requirements for suppliers are the most popular methods to ensure that OEMs can purchase environmentally proper materials and components. Supplier development is not common yet, but the answers suggest some movement in this direction. Unlike in traditional supply chain management,

automotive OEMs do not monitor the Tier 2 suppliers from an environmental aspect. Presumably this task is delegated to integrators (large Tier 1 suppliers); this assumption should be proved by further research. Green manufacturing and green logistics is part of the practices of nearly all companies, except for the forms of reuse and its logistics background.

Companies consider outcomes with an economic effect (economic and operative) the most important. Different types of cost reduction were chosen as most important performance indicators, which is in accordance with the intensive competition and price pressure in the industry. Regulatory pressure and growing consumer environmental awareness faced by the OEMs can explain the relatively high importance of environmental performance.

This research has limitations due to the small number of companies representing the OEM echelon of the supply chain in Hungary. The sample is not suitable for complex statistical testing. Further research can be done by comparing Hungarian results to other countries, and by extending the survey to other parts of the supply chain (Tier 1-4) or to OEMs in other branches of industry.

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